981

MACHINE SEWING

FOR

AIR SERVICE MECHANICS

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The following publication, entitled "Machine Sewing for Air Service Mechanics," is published for the information and guidance of all concerned.

[062.1, A. G. O.]

BY ORDER OF THE SECRETARY OF WAR:

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General, Chief of Staff.

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The Adjutant General.

MACHINE SEWING.

Pillowslip method.—Where there are machine facilities it is becoming almost universal practice to do all of the covering of airplane parts by the pillowslip method. In this course of machine work we will make all of the different types of covers just as is done under "hand sewing," except that here we will sew every place possible on the sewing machine. Take, for instance, a wing cover: The procedure is the same as in the hand method, except that the trailing edge is sewed up entirely on the sewing machine and then the cover is slipped over the wing from the small end and wrong side out, and then pulled back over the large end of the wing. The ends are then sewed by hand as before, but here we have saved all that time before necessary to sew the long trailing edge by hand, besides saving considerable material by cutting down our allowance and waste. As much as 12 yards to the ship may be saved in this manner, and a much better job obtained and stronger than is possible under the old method. Of course, to obtain good results more skill is required in the use of the machine and in cutting and sewing, in order that when put on the wing the fabric will be of correct and even tension throughout.

Especially is it urged upon the student to pay particular attention to and gather all the information on the sewing machine that he can, and a large portion of the time in this division will be devoted to the correct operation and emergency repair of the sewing machine. It is just as important that the operator of a sewing machine be able to adjust it and remedy any minor faults and locate larger troubles with a sureness that will enable an intelligent order for parts as it is for the driver of an automobile going on a long trip through an uninhabited country to know thoroughly the machine he is driving.

Kinds of sewing machines.—The sewing machines now in extensive use are the single and double needle Singer sewing machines.

Care of machine.—Machines in constant use should be wiped clean of all oil and dirt at least once every day. When not in use fabric

covering should be kept over machine heads to keep out dust and dirt. Constant care and watchfulness is necessary in order to keep all parts in proper order, so as to secure best working results of the machine.

Speed.—When machine is new, it should be run somewhat slower than the maximum speed until the reciprocating parts have had time to wear in.

Sizes of needles and thread for different fabrics.—For sheetings, muslins, and all classes of general work, use 60 to 80 cotton thread, A and B silk thread, and No. 14 needles. For all light woolen goods, heavy silk, seaming, stitching, etc., use 40 to 60 cotton thread, C silk thread, and Nos. 16 and 17 needles.

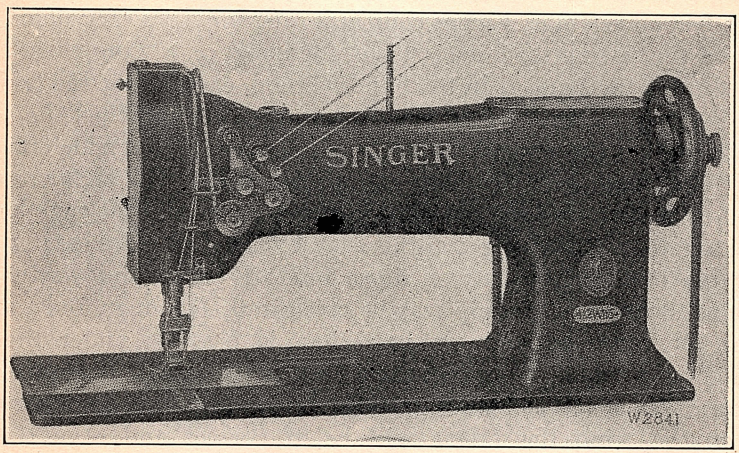

FIG. 1.—Singer double-needle sewing machine.

For upholstery, clothing, tickings, etc., use 30 to 40 cotton thread, D silk thread, and No. 18 needles.

For heavy woolens, bags, and heavy clothing generally, use 24 to 30 cotton thread, 60 to 80 linen thread, and No. 18 needles.

For bags, coarse cloths, and heavy goods use 16 to 20 cotton thread, 40 to 60 linen thread, and No. 21 needles.

For extra heavy work, use 8 to 16 cotton thread, 24 to 40 linen thread, and Nos. 22 and 23 needles.

To run the machine.—The balance wheel must always turn over toward the operator. Do not run the machine with the presser foot resting on the feed without cloth under the presser foot.

Do not run the machine when both bobbin case and needle are threaded unless there is material under the presser foot.

Do not try to help the machine by pulling the fabric or needle will be bent; the machine feeds the work without assistance.

The slide over the bobbin case should be kept closed when the machine is in operation.

To determine twist of thread.—Left-twist thread should be used in the needle. Either right or left twist thread can be used in the bobbin. With spool on right-hand side and pulling thread toward left side, take thread between thumb and forefinger of each hand. Turn the thread over toward you between thumb and forefinger of the right hand; if left twist, the strands will wind tighter; if right twist, the strands will unwind.

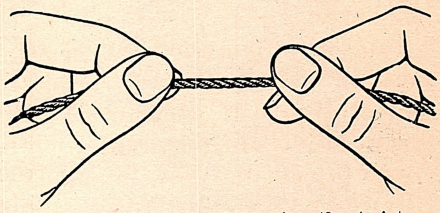

FIG. 2.—How to determine the twist.

To remove the bobbin.—Turn balance wheel over toward you until needle moves up to its highest point. Draw out slide in bed of machine, reach down with thumb and forefinger of left hand, open bobbin case. While the latch remains open, bobbin is retained in

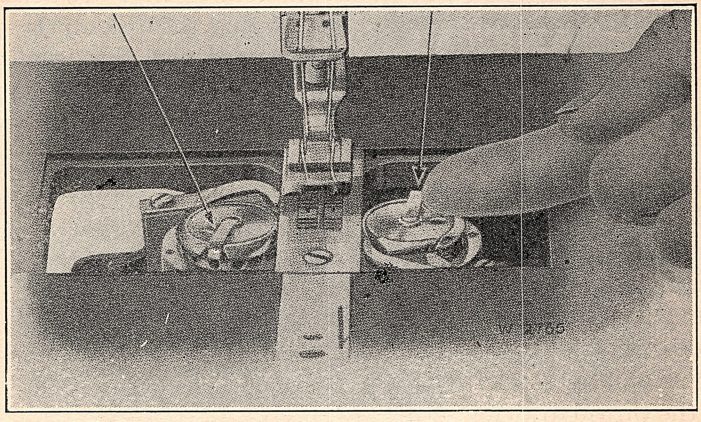

FIG. 3.—Removing the bobbin.

bobbin case. Release the latch, turn the open end of the bobbin case downward and the bobbin will drop out.

To wind the bobbin.—Fasten the bobbin winder to the table with its driving pulley in front of the machine belt so that the pulley will drop away from the belt when sufficient thread has been wound upon the bobbin. Place the spool of thread on the lower spool holder of the unwinder. Pass the thread from the spool up and from left to

right through the hole (1, fig. 4), down through the thread guide (2, fig. 4), in the tension bracket, and around the back of and between the tension disks (3, fig. 4). Place the bobbin-winder spindle; pass the end of the thread between the bobbin (4, fig. 4) and the disk on the spindle, then push the bobbin up closely against the disk, and the end of the thread will be held between the bobbin and the disk. With the left hand hold the bobbin-winder driving pulley, and at the same time with the right hand turn the disk on the bobbin-winder spindle over from you to expand the spindle, thus fastening the bobbin. Then push the bobbin-winder pulley over against the machine belt and start the machine. When sufficient thread has been wound upon the bobbin the bobbin winder will stop automatically. To release the bobbin, turn the disk on the spindle over toward you, then cut the tail thread off inside of the bobbin and the thread leading from the spool and remove the bobbin.

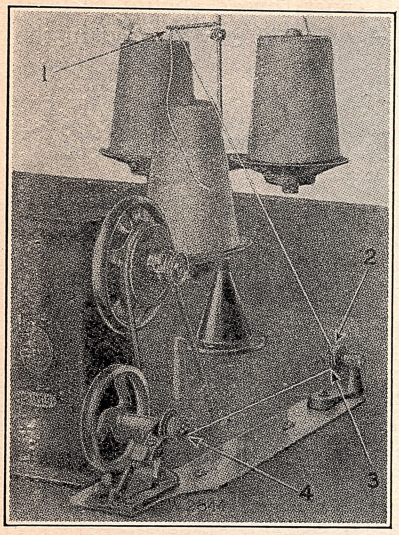

FIG. 4.—Winding the bobbin.

Bobbins can be wound while the machine is stitching.

To replace the bobbins and thread the bobbin cases.—The following instructions apply to both bobbins: Hold the bobbin between the thumb and forefinger of the left hand, the thread drawing on top from the right toward the left (see fig. 5) and place it on the center stud of the bobbin case, then push down the latch as shown in figure 6. Draw the thread into the slot (1, fig. 6) and back of the projection (2, fig. 7), leaving a loose end of thread about 2 inches long above the slide. When closing the slides leave just enough space for the threads to pass through.

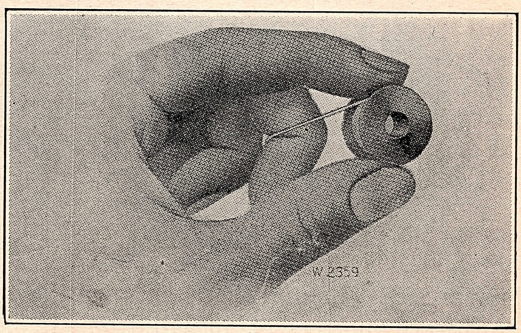
FIG. 5.—Direction of thread on bobbin.

To thread the needles.—To thread the outside needle or the one farthest from the upright arm, pass the thread from the left spool on the spool stand, through the left hole at the top of the spool stand, down and from back to front through the hole (1, fig. 8) in the pin on top of the machine, then from right to left through the hole (2) in the pin through the upper thread retainer (3) over from right to left between the left tension disks (4), down under from right to left around the thread controller (5), into the thread controller spring (6) and up through the staple (7), up and from right to left through the upper hole (8) in the end of the thread take-up lever, down through the staple (7) again and through the two thread guides (10) and (11), down through the left hole (12) in the needle holder and from right to left through the eye of the left or outside needle (13).

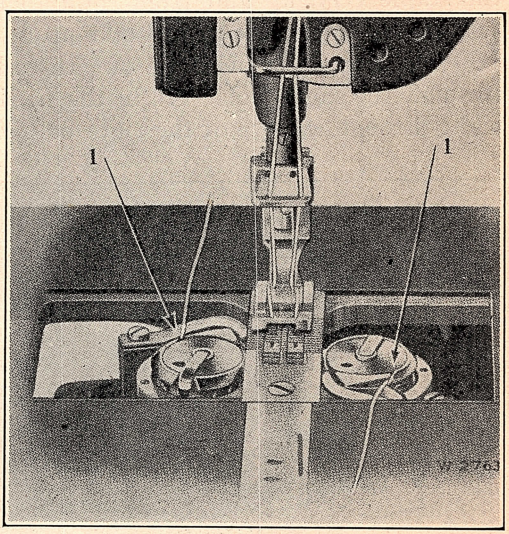

FIG. 6.—Threading the bobbin cases.

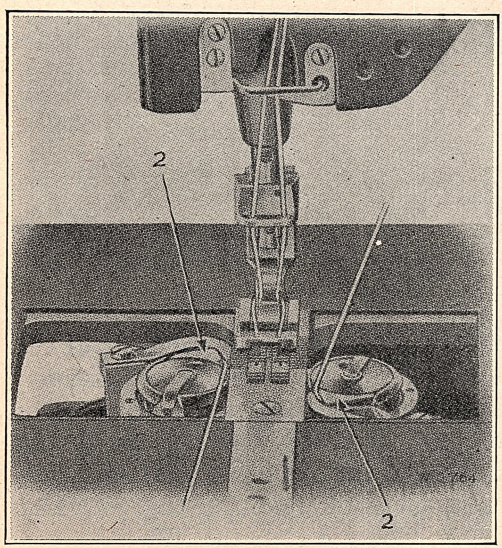

FIG. 7.—Threading the bobbin cases.

To thread the inside needle, or the one nearest the upright part of the arm, pass the thread from the right spool on the spool stand through the right hole at the top of the spool stand down, and from back to front through the hold (A) in the pin on top of the machine, then up and from right to left through the hole (B) in the pin, through the lower thread retainer (C) under from right to left between the right ten-

sion disks (D), down under from right to left around thread controller (E), into the thread controller spring (F) and up through the staple (G), up and from right to left through the lower hole (H) in the end of the thread take-up lever, down through the staple (G) again and through the two thread guides (J and K), down through the right hole (L) in the needle holder and from left to right through the eye of the right or inside needle (M).

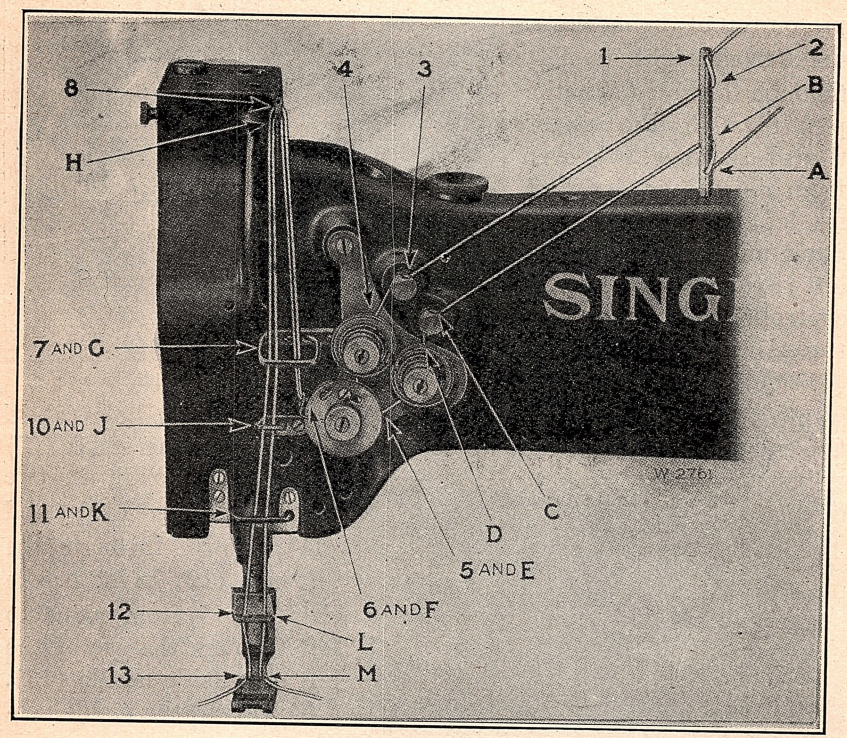

FIG. 8.—Threading the needles.

To prepare for sewing.—With the left hand hold the ends of the needle threads, leaving them slack from the hand to the needles. Turn the balance wheel over toward you until the needles move down and up again to their highest point, thus catching the bobbin threads; draw up the needle threads and the bobbin threads will come up with them through the holes in the feed dog (fig. 9). Lay the threads back under the presser foot and close the slides.

To commence sewing.—Place the material beneath the presser foot and commence to sew, turning the balance wheel over toward you.

To remove the work.—Have the thread take-up lever at the highest point, raise the presser foot, draw the work back and cut the threads close to the goods. Lay the ends of the threads back under the presser foot.

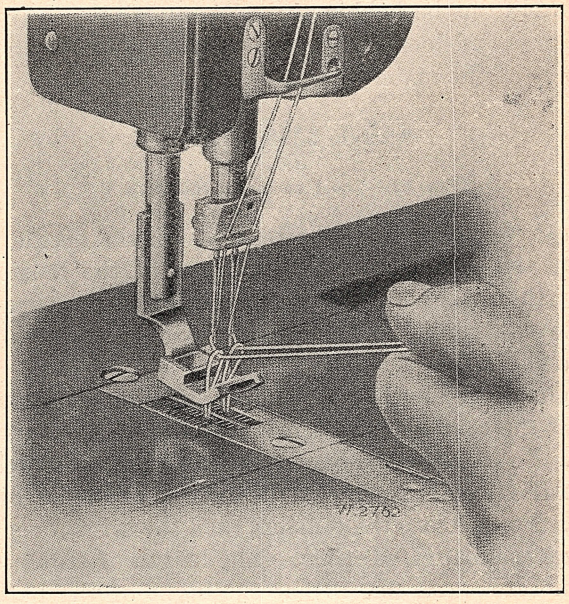

FIG. 9.—Drawing up the bobbin threads.

Tensions.—The needle and bobbin threads should be locked in the center of the thickness of the material, thus:

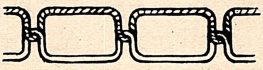

FIG. 10.—Perfect stitch.

If the tension on the needle thread is too tight, or if that on the bobbin thread is too loose, the needle thread will lie straight along the upper surface of the material, thus:

FIG. 11.—Tight needle thread stitch.

If the tension on the bobbin thread is too tight, or if that on the needle thread is too loose, the bobbin thread will lie straight along the under side of the material, thus:

FIG. 12.—Loose needle thread stitch.

To regulate the tensions.—The tensions on the needle threads are regulated by the thumb nuts at the front of the tension disks on the front of the machine. To increase the tension, turn the thumb nuts over to the right. To decrease the tension, turn the thumb nuts over to the left.

The tensions on the bobbin threads are regulated by means of the screw nearest the center of the tension spring on the outside of each bobbin case. To increase the tension, turn the screw which is nearest the center of the tension spring on the outside of the bobbin case over to the right. To decrease the tension, turn the screw over to the left.

To regulate the length of stitch.—The length of stitch is regulated by the thumbscrew (A, fig. 13) at the right of the balance wheel. There is a notch in the hub of the balance wheel as shown in figure 13, and the number appearing in the notch shows the number of stitches to the inch that the machine is ready to make.

To lengthen the stitch, turn the thumbscrew (A) over toward you. To shorten the stitch, turn the thumbscrew over away from you.

To regulate the pressure on material.—The pressure on the material is regulated by the thumbscrew (A, fig. 16) at the back of the machine, the screw acting on a flat spring. To increase the pressure, turn the screw downward. To decrease the pressure, turn the screw upward. The pressure should be only heavy enough to enable the feed to move the work along evenly.

To oil the machine.—To insure easy running and prevent unnecessary wear of the parts which are in movable contact, the machine

requires oiling, and when in continuous use it should be oiled at least once each day.

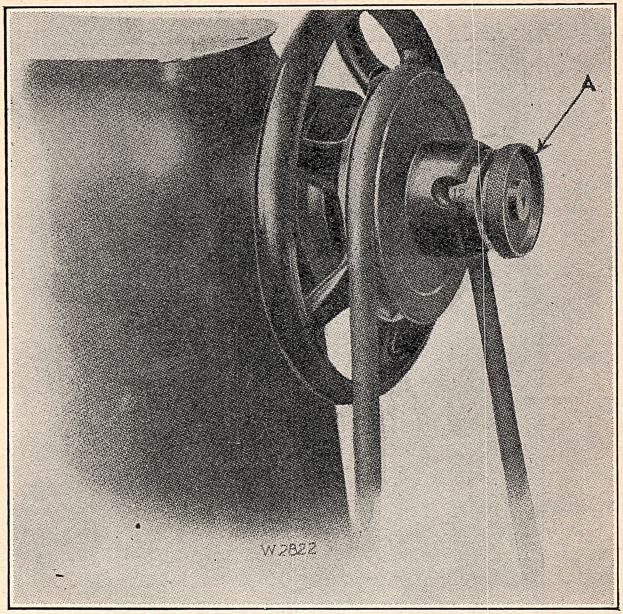

FIG. 13.—Stitch regulator.

Oil should be applied at the places designated by arrows, as shown in figures 14, 15, 16, and 17. Swing back the cover which is on the

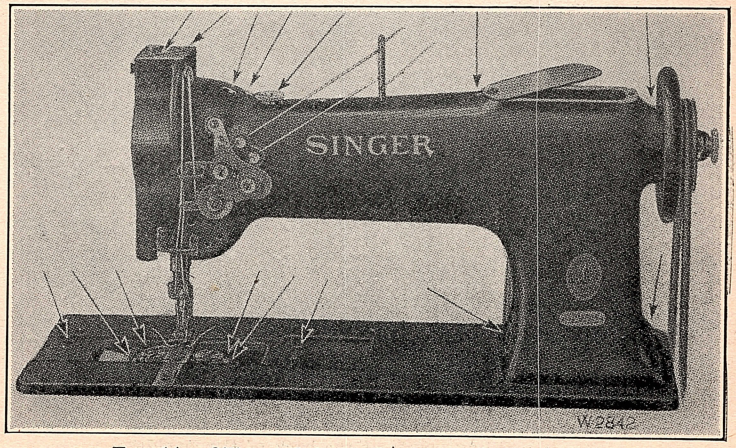

FIG. 14.—Oiling points at the front of the machine.

top of the machine at the right and oil the bearings which are thus covered, then replace the cover.

Loosen the thumbscrew in the upper end of the faceplate, turn the faceplate upward, and oil the wick and bearings which are thus covered, then turn down the faceplate and tighten the thumbscrew.

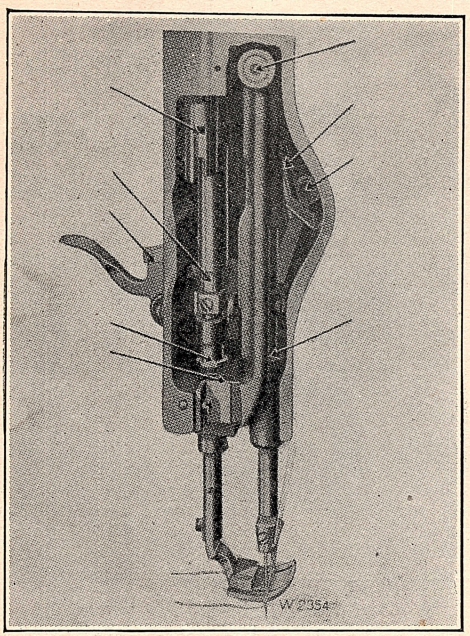

FIG. 15.—End of machine, showing oiling points.

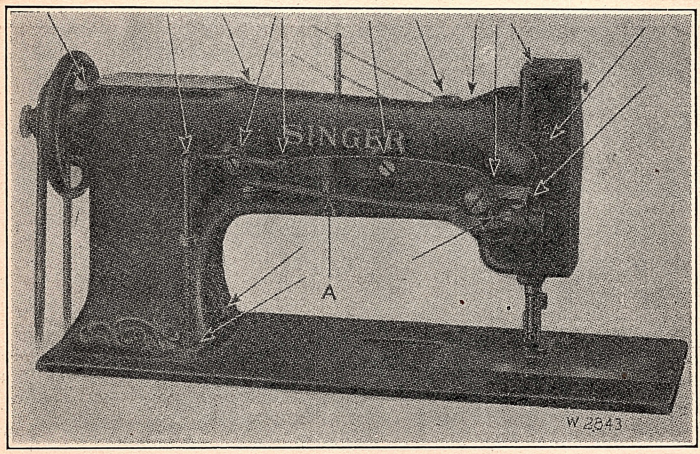

FIG. 16.—Oiling points at the back of the machine.

Turn the machine back on its hinges and apply oil at the places designated by arrows, as shown in figure 17, and all other places

where there are parts in movable contact, then bring the machine forward into place.

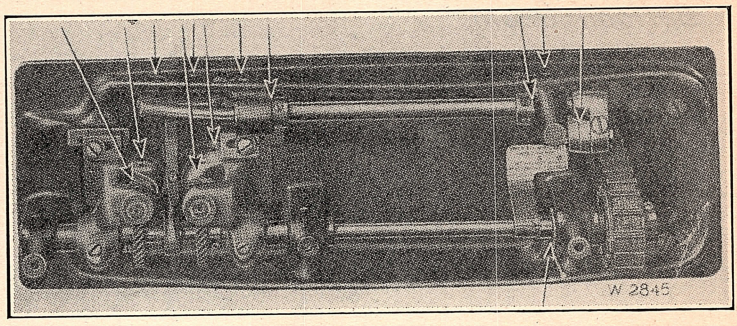

FIG. 17.—Base of machine, showing oiling points.

Oil the bobbin-case bearings in the bobbin-case races each time a bobbin is replaced.

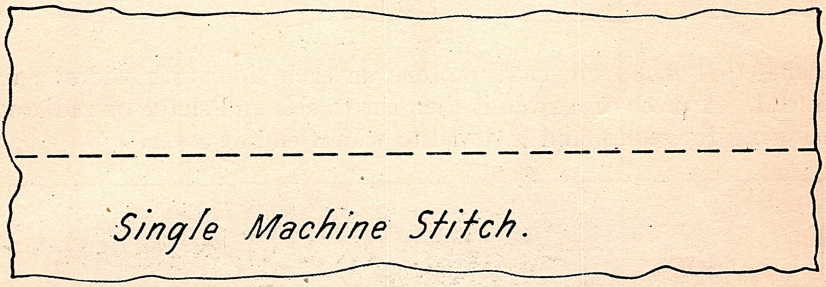

FIG. 18.

MISCELLANEOUS ARTICLES.

Canvas.—Canvas comes in bolts usually 30 inches in width, of 55 yards to the bolt.

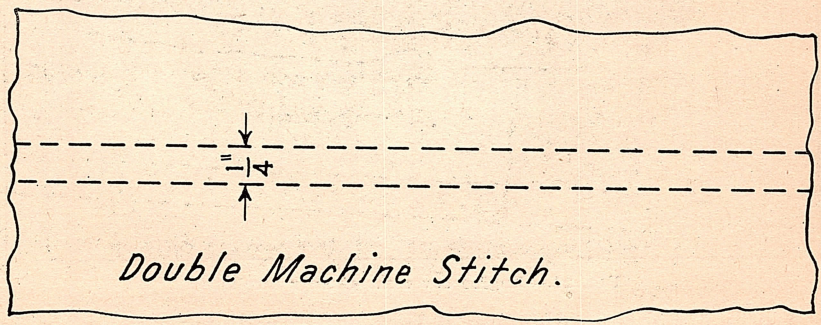

FIG. 19.

Engine covers.—Two strips of canvas 5 feet long are sewed together, and two strips each 4 feet long, tapering in width from 11

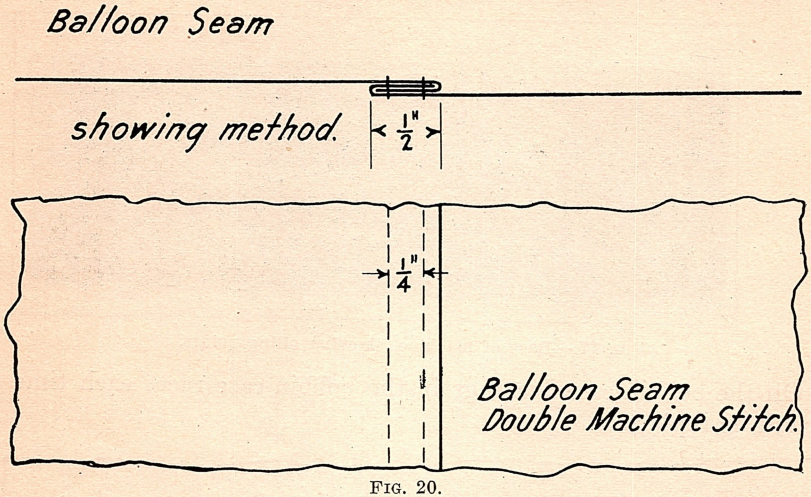

FIG. 20.

inches to 1 inch, are sewed on, one on each side, with widest part at end. A piece of canvas is then cut to size and shape of radiator, allowing for seams, and is sewed to widest end of cover.

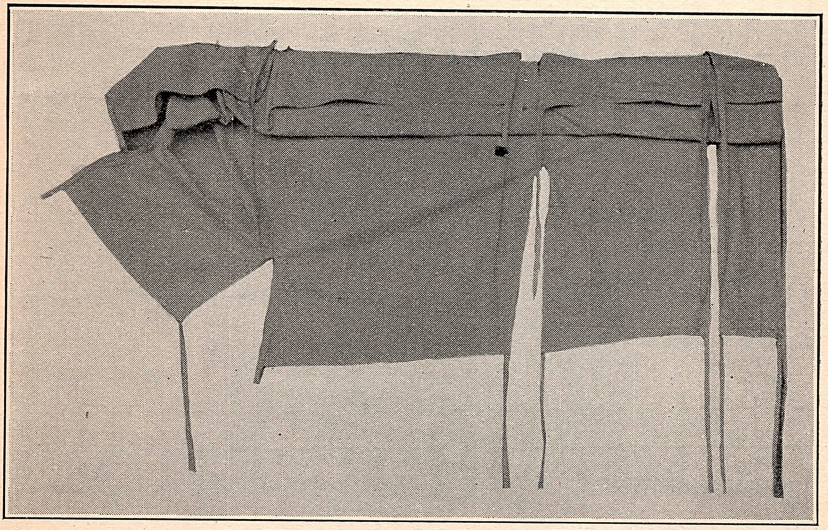

FIG. 21.—Engine cover for Curtiss airplane.

A hole 6 inches in diameter is then cut in radiator cover at center to allow for propeller shaft, and a slit is made from this shaft hole

downward. There are three slits in each side of engine cover, varying in length from 12 inches to 24 inches, for wires and struts. A

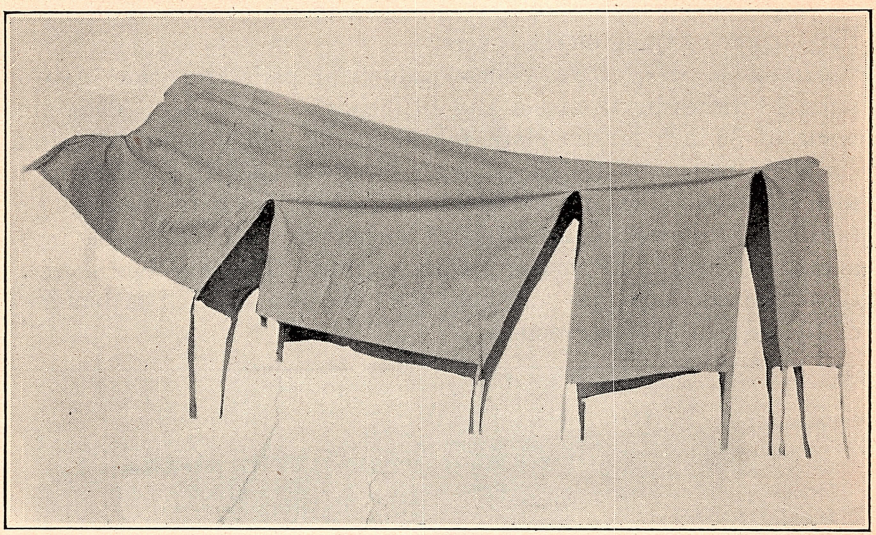

FIG. 22.—Engine cover.

number of strings and loops are attached to the corners of slit openings for tying on cover around wires, struts, and fuselage body.

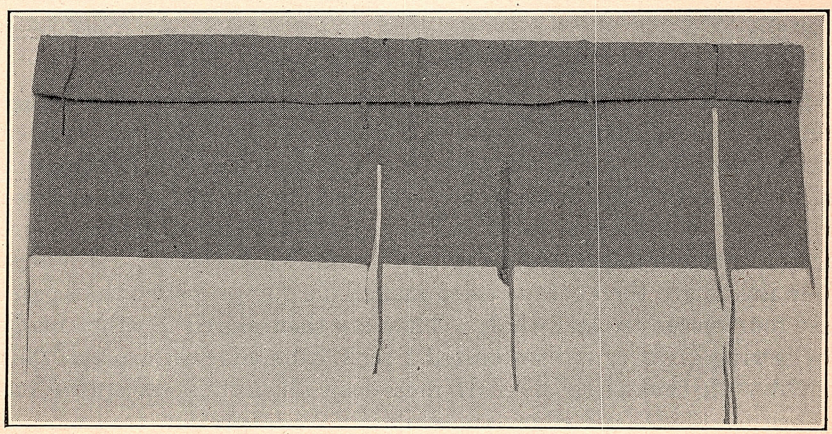

FIG. 23.—Cockpit cover for Curtiss airplane.

Cockpit covers.—Cockpit covers are made of two strips of canvas, each strip being 8 feet 6 inches in length. These two strips are sewed together and slits are made at three places in each side. The slits

vary in length from 15 inches to 24 inches. The edges of these slits are always bound with narrow strips of canvas to keep them from fraying. Strings and loops are attached to the corners of slits for the purpose of tying on the covers.

Pillows or wing pads.—These pillows or pads are made in two sizes, 18 inches by 18 inches and 10 inches by 18 inches. They are made of 36-inch muslin cloth folded in the center lengthwise and cut to 10 inches by 18 inches size. They are backstitched one-half inch in on the sides, turned inside out, and filled with shavings or sawdust. Pillows 18 inches by 18 inches are filled with shavings and the 10 inch by 18 inch size with sawdust. The open end is then turned in one-half inch and overcast. Pillows are tied in bundles of 10 and sent to stock room.

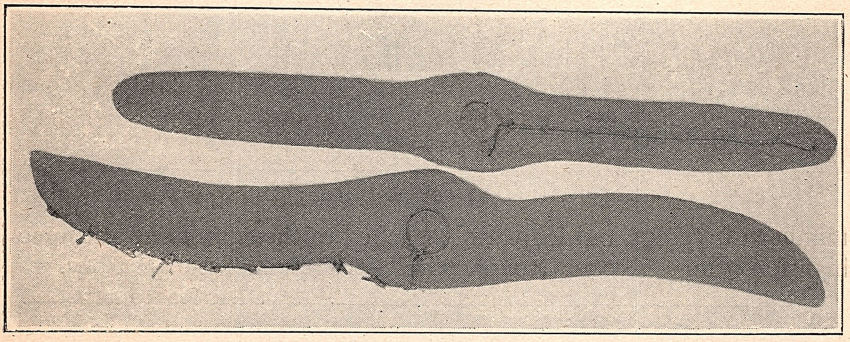

FIG. 24.—Two styles of propeller covers.

Propeller cover.—Propeller covers are usually made of 10-ounce canvas. When making covers in quantities the canvas is folded eight times, full length of pattern for each fold. By folding the width of cloth, two pieces for covers may be cut out at once from pattern with but little waste. The eight thicknesses of canvas are pinned through to prevent creeping of cloth while cutting. The first four layers are then cut, so as to make hole for propeller shaft, and last four pieces are left whole. They are then paired together ready for sewing. Cover is then basted 1 inch from edge all around, then sewed with backstitch one-half inch deep all around, excepting entrance for blade, and edges are whipstitched to prevent fraying.

Hole for propeller shaft is bound with a 2-inch strip of canvas. End is turned back 1½ inches and backstitched with one-half-inch seam. This hem is then threaded with a half-inch canvas strap 52 inches long and tacked fast in center to hold it from slipping back and forth.

Cover is then turned, and outside seam is pulled and basted $\frac{1}{2}$ inch from edge. After this is done, it is machine stitched $\frac{1}{8}$ inch all around. Bastings are then removed, covers pressed, and sent to stock room.

DOPING, VARNISHING, AND PATCHING.

How to repair rips and tears.—The rips or tears should be sewed with a baseball or overhand stitch. Baseball stitches are better because of their greater strength. Stitches should be started 1 inch above rip and stitched 1 inch beyond rip to prevent the rip from tearing out or getting any larger, if break occurs after having been

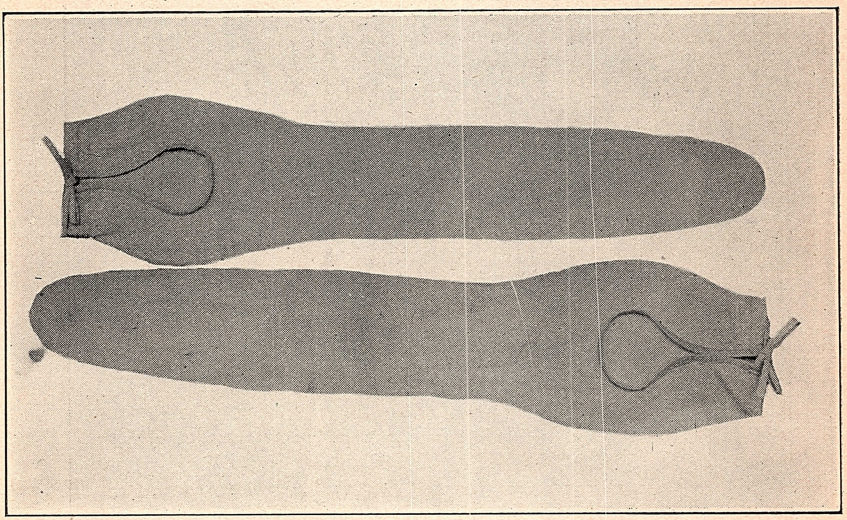

FIG. 25.—Showing notched holes for propeller shafts.

repaired. For neat, strong work, stitches should be $\frac{1}{4}$ inch back from edge of rip or tear and $\frac{1}{4}$ inch apart.

After sewing of rips or tears is completed, take off old dope by applying new dope or acetone and remove by rubbing briskly with a cloth.

Cut cloth for patch 2 inches larger all around than rip or tear and with square corners. Edges should be frayed $\frac{1}{4}$ inch to give dope good holding power. Cover the rip with dope and put on doped patch. Care should be taken to see that all frayed edges are smoothed out straight. Now apply at least three or four coats of dope, allowing plenty of time for drying between coats, and one or two coats of varnish and the repair is complete.

Patching holes less than 3 inches in diameter.—Patches over holes less than 3 inches in diameter should be doped on. First, take off all the old varnish by applying new dope or acetone for a space of 2 inches from edge all around the hole. Cut a patch with square corners 2 inches larger than the hole, fray all edges ¼ inch, dope edges of hole as far as patch will reach, and put patch on, first doping side of patch to be applied. Keep frayed edges straight. Several coats of dope and one or two coats of varnish are necessary to complete the work and make a good strong job.

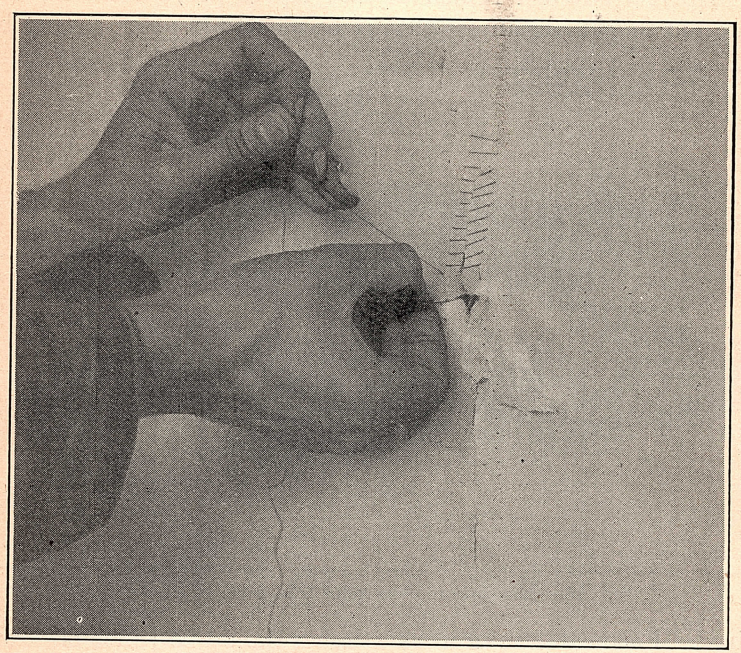

FIG. 26.—Repairing ripped fabrics.

Patching holes greater than 3 inches in diameter.—When the hole is greater than 3 inches in diameter, the patch should be sewed in. Use great care to do a good, smooth job. If edges of holes are uneven or ragged, trim out evenly without making hole any larger than necessary. Now round out the corners and turn back all the edges ¼ inch.

This can be done by cutting back into the fabric at the corners in several places about ¼ inch deep and ¼ inch apart. This prevents ripping or tearing out of fabric while sewing.

Apply dope or acetone, and remove varnish. Next cut cloth for patch from ½ to 1 inch larger than the hole and sew in evenly, turning in edges of patch as necessary. Stitches should be taken from ⅛ to ¼ inch in depth.

Another patch is now cut 2 inches larger all around and properly doped over the patch that was sewed in. Several coats of dope and two coats of varnish complete the work.

To repair corners on wings.—First cut away as much of the old material or fabric as may be necessary. Remove varnish by using

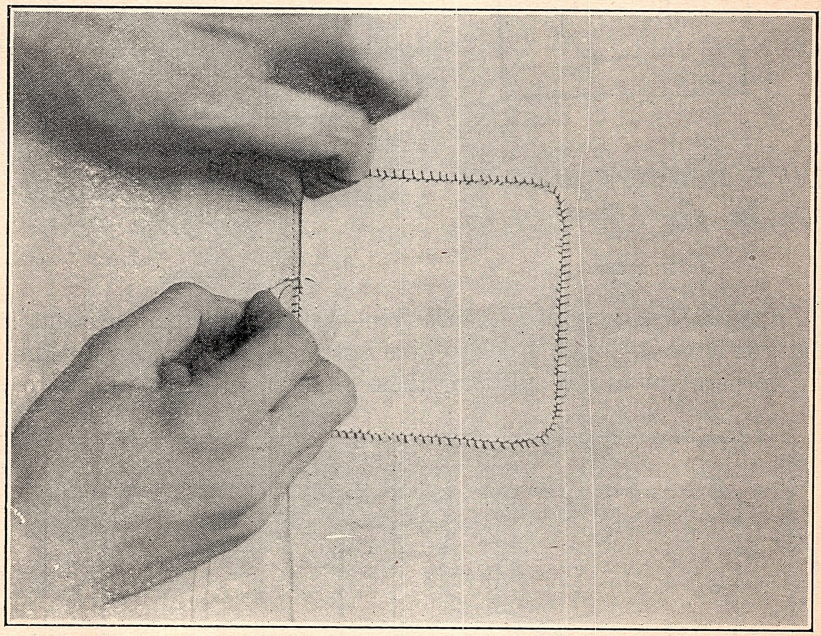

FIG. 27.—Sewed-in patch.

dope or acetone where seams will occur. Cut two pieces of cloth the same shape and size, fitting same properly over wing corner, allow ½ inch on all edges for seams, backstitch the part which will fit around corner, turn inside out and double-stitch down ¼ inch, then fit over corner, pin or tack it so that it will not slip out of place, turn edge in ¼ inch and turn in ½ inch on the new corners being repaired and sew with baseball or overhand stitch.

When sewing is completed, remove dope along the seams 1½ inches on each side. Now dope on breaker strips as follows: Where seam runs from corner toward center of wing, put breaker strip on first;

then cover seams running parallel with the ribs; and, lastly, the breaker strip that covers the edge of the wing.

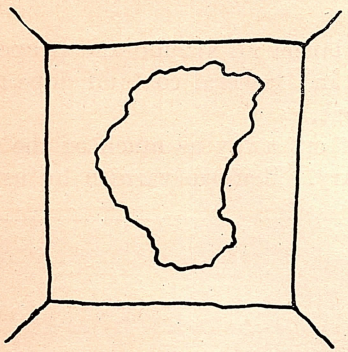

FIG. 28a.

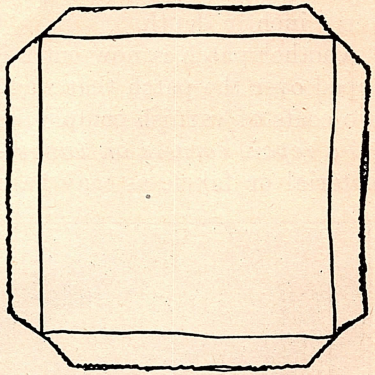

FIG. 28b.

To repair corners with handholds.—Edges of fabric are cut as much as is necessary in order to give a strong edge for seams. Make the corners round by splitting them in two or three places to a

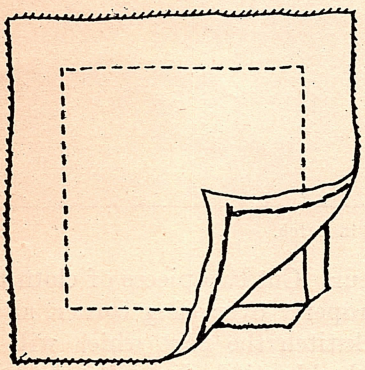

FIG. 29a.

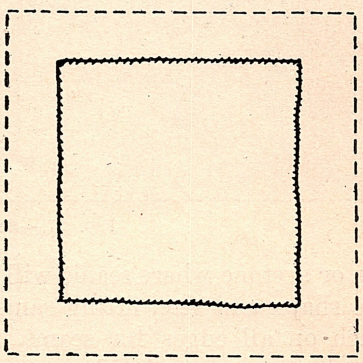

FIG. 29b.

depth of $\frac{1}{4}$ inch each and turn in all edges. Remove varnish with acetone. Take measurements for proper size, cutting fabric for corners.

Cut cloth in two parts, allowing ½ inch for seams. Part that fits on edge of wing is backstitched ½ inch and double-stitched ¼ inch. Fabric is then tacked or pinned on over the edge to prevent it from pulling from one side or the other, and is then sewed the same as the other corners. Next cut material in center of handhold a length of about 2 inches and split the cloth all around about ¼ to ½ inch apart on both sides. Dope or glue these edges to inside of handhold. Cut a small strip width of handhold, and long enough to circle around on the inside, and dope same around on inside of

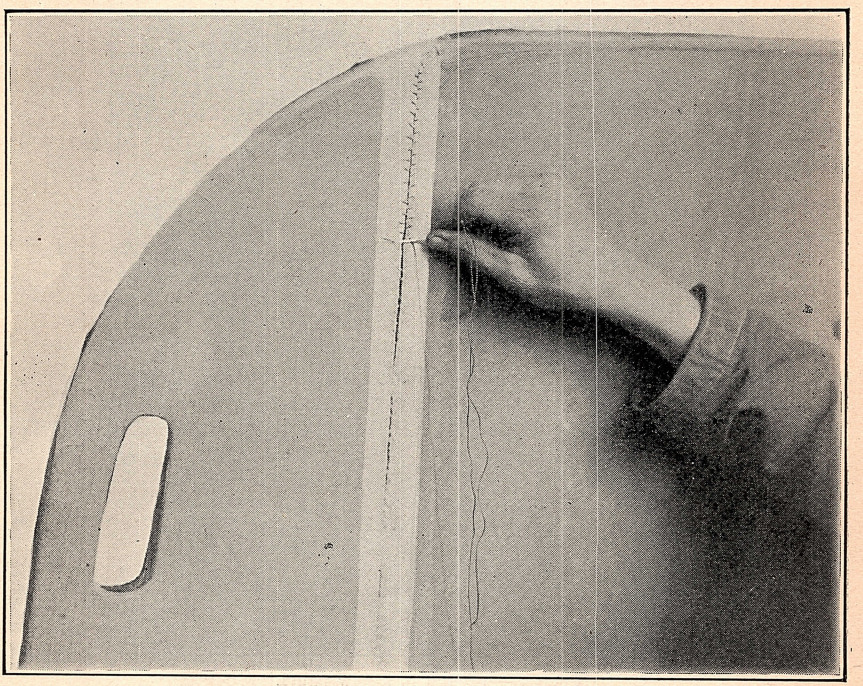

FIG. 30.—Handhold repair of corner.

handhold. Cut a patch to extend 2½ inches back from edge of handhold toward center of wing, and 1 inch from outside edge of wing. Dope it on and finish by covering all seams with breaker strips, putting them on in same order as was explained for putting on a new corner. Apply several coats of dope and two coats of varnish.

How to put in new panels.—First method: Cut out old panel, leaving enough of old edge so that when it is turned in one-half inch the edge will be in center of the ribs. Remove dope from edges of old fabric. Measure panel and cut cloth, allowing one-half inch for

seams. Sew in cloth with baseball stitch. Apply one coat of dope, then put on breaker strips and then sufficient number of coats of dope, then varnish.

Second method: Cut out old panel. Edges on old panel are not turned in. Cut cloth to right size and tack on properly, tacks about 1½ inches apart. Use copper or brass tacks. Apply first coat of dope.

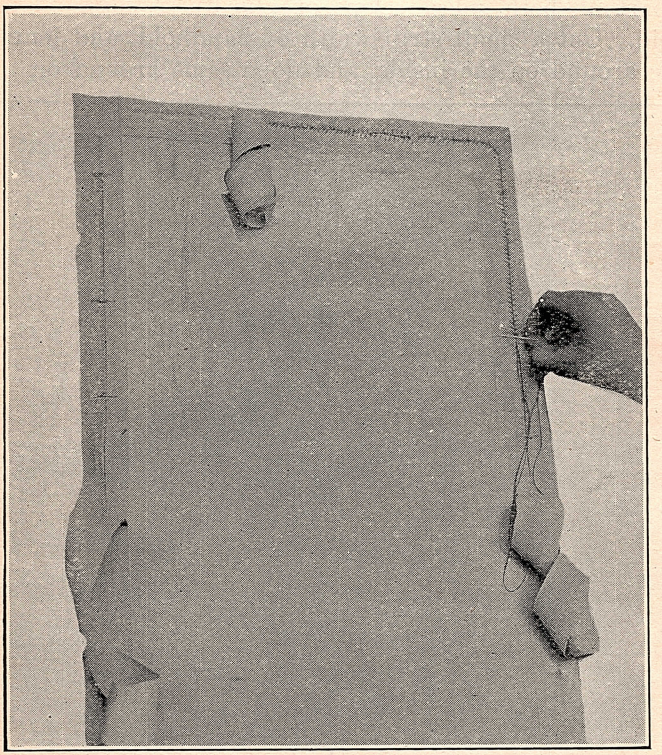

FIG. 31.—Sewing in a new panel.

In both first and second methods put in lock stitches whenever necessary before applying breaker strips. After breaker strips are put on dope a sufficient number of times and then varnish.

How to put linen tip on propeller.—First remove any old glue or paste and make sure that tip is perfectly clean. Take a piece of linen and fit on tip where groove is shown. Dope part that fits in groove, and cut off surplus material, leaving only enough to cover edge. (Flat side is covered first.) Put linen on other side in like manner; get a good smooth finish to the job and then varnish.

How to wrap with flax thread or breaker strips.—Struts are wrapped to prevent splintering and to give them additional strength. To begin wrapping a strut with flaxen thread lay end of thread on in loop fashion. Wrap from No. 2 toward No. 1 until near enough to edge to slip end through the remaining loop and pull both ends in

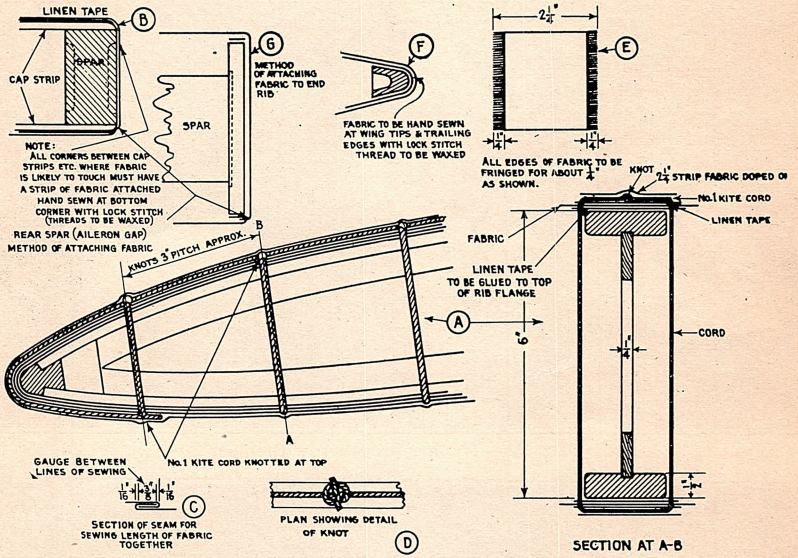
LINEN TAPE
B
SPAR
CAP STRIP
G
METHOD OF ATTACHING FABRIC TO END RIB
SPAR
NOTE:
ALL CORNERS BETWEEN CAP STRIPS ETC. WHERE FABRIC IS LIKELY TO TOUCH MUST HAVE A STRIP OF FABRIC ATTACHED HAND SEWN AT BOTTOM CORNER WITH LOCK STITCH (THREADS TO BE WAXED)
REAR SPAR (AILERON GAP)
METHOD OF ATTACHING FABRIC
KNOTS 3" PITCH APPROX.
B
A
F
FABRIC TO BE HAND SEWN AT WING TIPS & TRAILING EDGES WITH LOCK STITCH THREAD TO BE WAXED
2½"
E
ALL EDGES OF FABRIC TO BE FRINGED FOR ABOUT ¼" AS SHOWN.
KNOT
2½" STRIP FABRIC DOPED ON
No.1 KITE CORD
LINEN TAPE
FABRIC
LINEN TAPE TO BE GLUED TO TOP OF RIB FLANGE
A
CORD
GAUGE BETWEEN LINES OF SEWING
No.1 KITE CORD KNOTTED AT TOP
C
SECTION OF SEAM FOR SEWING LENGTH OF FABRIC TOGETHER
PLAN SHOWING DETAIL OF KNOT
D
SECTION AT A-B

DIAGRAM SHOWING METHOD OF FIXING FABRIC TO RIBS

FIG. 32.

opposite directions until the half hitch is drawn in the center of the wrapping. Dope it three or four times and then varnish.

To wrap with breaker strips wrap in spiral form, having spirals 1 inch apart. Strut is covered entirely in this manner and then doped or varnished.

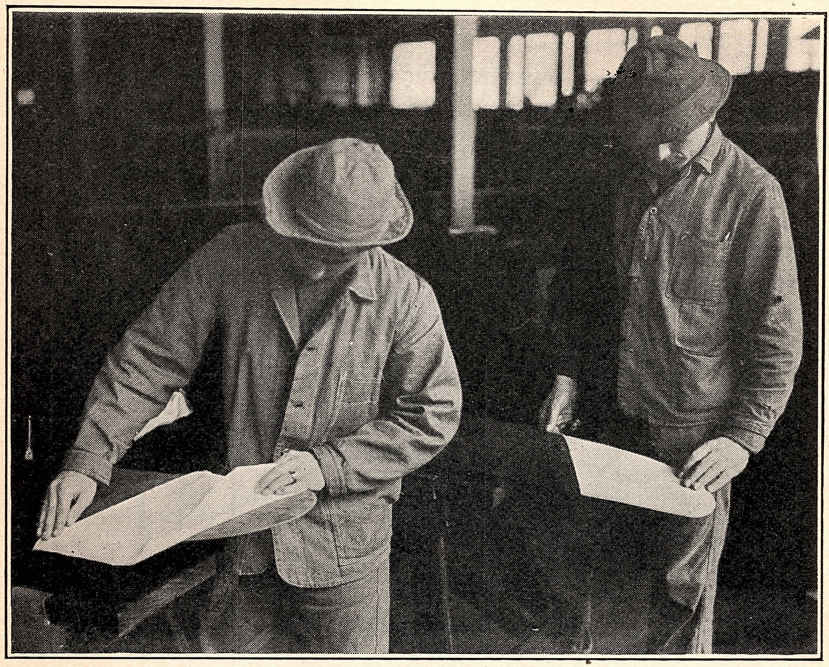

FIG. 33.—Tipping propeller with linen.

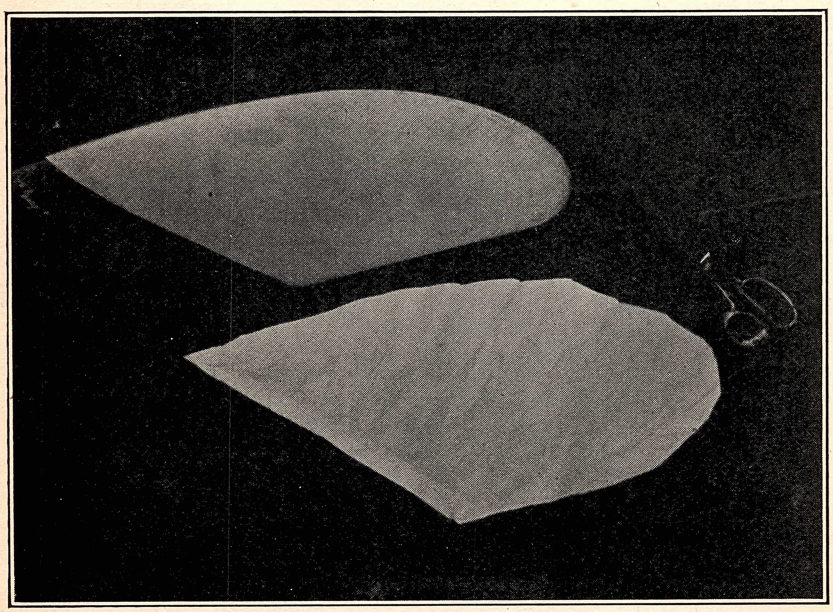

FIG. 34—Finished propeller tip.